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ABSTRACT

Establishment of the federal-state Employment Service system created a need for a standardized occupational language to ensure uniform matching of workers with jobs. The Occupational Analysis Research Program was initiated to gather a broad base of detailed occupational information. Although the organizational structure of all editions of the Dictionary of Occupational Titles (DOT) has differed to varying degrees, the basic intent has remained to identify jobs and provide a tool for the employment service to match workers with jobs. Today's users and uses extend far beyond that basic intent. The DOT is widely used by educational institutions, government agencies, companies, and nonprofit agencies for career and vocational counseling, library reference, rehabilitation counseling, personnel management, employment placement, and research. Data collection has an industry approach. Research efforts are focused on the study of selected industries to document jobs that have undergone the most significant changes. Terms used in job analysis have definitions developed by the U.S. Employment Service. The job analysis method approved for use by the Employment Service recognizes two major dimensions of job information--Work Performed and Worker Characteristics. A combination of observation and interview is the traditional method of data collection. Individual job analysis reports are evaluated and grouped, based on analysis of tasks performed, for use in formulating and writing occupational definitions. (YLB)

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EVOLUTION OF JOB ANALYSIS AND
THE *DICTIONARY OF OCCUPATIONAL TITLES (DOT)*
IN THE U. S. EMPLOYMENT SERVICE

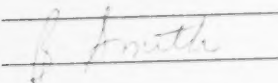
Historical Perspective of the Occupational
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HISTORICAL PERSPECTIVE OF THE OCCUPATIONAL ANALYSIS RESEARCH PROGRAM AND OVERVIEW OF CURRENT METHODOLOGIES

The broad objective of this presentation is to provide historical information on the Occupational Analysis Research Program of the United States Employment Service (USES) and an overview of the research methodologies currently in use. Specifically, information will be provided on the development and evolution of the occupational analysis program and products, and how today's program approaches fulfilling its basic mission -- identifying, defining, and classifying all jobs existing in the economy. In describing current practices and procedures, emphasis will be placed on how industries, establishments, and jobs within establishments are selected and studied, and how data collected from diverse sources are combined into occupational definitions for inclusion in the Department of Labor's *Dictionary of Occupational Titles (DOT)*.

History. The Wagner-Peyser Act of 1933 established the Federal-State Employment Service system to cope with the staggering unemployment of the depression years. The Employment Service was responsible for matching workers with jobs, providing occupational guidance, and determining worker qualifications for successful job performance as well as recruiting relationships between jobs. It was soon recognized that a standardized occupational language was required to ensure that all Employment Service offices uniformly matched workers with jobs.

In response to that need, a federal occupational research program was initiated, as one facet of the Employment Service Program, to gather a broad base of detailed occupational information.

An advisory board representing industry, government, and education was designated to oversee the program's development. It was determined that two broad principles would govern this research effort:

- 1) An initial period of very extensive gathering and processing of data was necessary to provide an overall picture of the occupations that exist in the American economy together with a standardized concept of the nature of each occupation; and
- 2) All data should be gathered from original sources through the observation of workers in the working environment in order to reflect occupations as they exist rather than to build up an academic statement of an ideal occupational structure.

The job analysis techniques developed in the early stages of the program reflected the job market situation of the times, that of a surplus of qualified workers and a shortage of jobs. Consequently, the data collected emphasized the tasks performed and placed little

emphasis on identifying characteristics required of the worker. The only worker-related information being gathered related to the qualifications a worker must bring to the job, i.e., experience, training, and performance requirements. Analysis of the job in terms of the presence and degree of each performance requirement or factor (responsibility, job knowledge, mental application, dexterity and accuracy) served to establish the level of difficulty of the tasks described in the work performed.

Information was collected on an industry-by-industry basis by analysts working in federal research centers across the nation. As research in a particular industry was completed, detailed job descriptions for that industry were published in single or multiple volume sets.

By the late 1930's, a sufficient amount of data on jobs in the economy was available, both in published and unpublished format, to make it feasible to prepare a single volume of brief descriptions for all occupations for which there was information available -- in short, a dictionary of occupations. Additionally, it was becoming increasingly apparent that the multiple volumes of industry-specific data needed to be condensed into a more easily referenced tool for use by local employment service staff.

Development of the format and content of information to be published in the proposed dictionary also provided a basis for review of the occupational classification and coding system of the Employment Service and resulted in the modified classification structure used in the First Edition of the *DOT*.

This First Edition was released in 1939 and was published in three hard-bound volumes or parts. Part I contained approximately 17,500 occupational definitions arranged alphabetically. The information provided for each occupation included a base title and any alternate titles by which the job was known, the industry or industries in which the occupation was found to exist, and a short statement of work performed. Occupations were also assigned a five- or six-digit code that grouped closely-related occupations and those occupations that involved similar tasks, as well as indicated whether the occupation was considered "skilled, semiskilled, or unskilled." Part II provided a Group Arrangement of Titles and Codes, and Part III was simply a conversion table -- old ES codes to the new codes in the *DOT*.

The First Edition proved even more valuable than its originators could have imagined. In addition to making the work of Employment Service interviewers and others involved in placement activities more effective, it proved to be of great value to personnel officers in private industry, private employment agencies, and others involved in the classification of worker skills. Although it was initially conceived in a period of depression, the *DOT* proved of immense value during World War II, providing the standard job terminology and code numbers which facilitated labor recruitment for war industries throughout the nation and aided in the transfer of workers from less-essential to high-priority industries. It made uniform job information available to Selective Service Boards and furnished a means of classifying the civilian skills of persons entering and leaving the Armed Forces. Three supplements to the First Edition were published between 1942 and 1945 that added approximately 6,000 new occupations to the data base.

By the 1940's, the economy and the job market was radically changed. No longer was there a surplus of qualified workers, instead there was a surplus of jobs needing to be filled. Highly selective recruitment on the basis of experience had passed from the scene and acceptance of inexperienced workers with the potential for successful performance on the job was becoming common place.

The need for mass registration of women, for recruitment of youth, for selection of trainees for war training courses, and for better utilization of handicapped workers emphasized the need for a system of evaluating jobs and workers' potential on the basis of factors other than work experience.

Prior to the impact of the war on labor supply and demand, a preliminary Entry Occupational Classification structure was developed to assist employment offices in classifying entry applicants that could not otherwise be classified in terms of specific occupations as defined in the First Edition *DOT*. When this preliminary classification structure was published, it was not expected that entry applicants would ever number more than a small percentage of the total available labor supply.

In 1944, more extensive worker traits information was published as Part IV of the First Edition. It contained information on jobs that had been analyzed and described in terms of personal traits, such as the ability to relate to abstract ideas, ability to plan, and memory for details. Part IV proved so useful that in 1949 when the Functional Occupational Classification Project was initiated for the development of a new classification system for jobs, it was with the objective that such classification would reflect not only what the worker does but also the requirements such work activities placed on the worker.

The first phase of this project was to categorize, define, and standardize the "work performed" and "worker traits" requirements and to manualize techniques and instructions for their use as criteria in the analysis of jobs. This, in essence, became the core of the new methodology for job analysis. A later stage of the Project involved the application of this methodology to the analysis of a selective sample of 4,000 jobs for these requirements. The traits components forming the basis for the occupational classification included General Educational Development, Specific Vocational Preparation, Aptitudes, Temperaments, Interests, Physical Demands, and Environmental Conditions.

Some of the resulting data were released in the 1956 publication, "Estimates of Worker Traits Requirements for 4,000 Jobs as Defined in the *Dictionary of Occupational Titles*." This new methodology provided the basis for research and development of the occupational classification structure and data collection procedures to be used for the Third and subsequent editions of the *DOT*.

The Second Edition was published in 1949 in two hard-bound volumes, and was essentially an expanded, reorganized version of the First Edition. Volume I contained approximately 22,000 alphabetically-arranged occupations and Volume II contained miscellaneous occupational and industrial classification information. A Second Edition supplement containing more than 2,200 new and revised definitions was released in 1955.

By the time the Third Edition was released in 1965, the *DOT* had become the standard, recognized source of occupational information in terms of job duties and activities. The Third Edition contained sweeping changes in both organization and concepts, including a revised and improved classification system. Occupational codes were expanded to six-digits for all occupations. The first three digits located a definition within an occupational group according to a combination of factors, such as work fields, purpose, product, service rendered, or industry. The last three digits reflected the worker's involvement with Data, People, and Things and the relative complexity of the job rather than the former, and somewhat discriminatory breakdown of "skilled, semiskilled, or unskilled."

The Third Edition was published in two hard-bound volumes. Volume I contained over 21,000 occupational definitions arranged alphabetically and Volume II contained information on the occupational code and occupational group arrangement. Volume II also contained a classification system based on "worker traits" needed to achieve average successful job performance.

In 1977, as a result of continued research into the changing occupational structure of the economy, the Fourth Edition *DOT* was published. Changes from the Third to the Fourth Edition were primarily in format and organization. Basic concepts were not changed.

The Fourth Edition was released in a single, soft-cover volume with occupations arranged by *DOT* code within a modified occupational group arrangement. The occupational code was expanded to nine-digits, with the first three indicating occupational group, the second three the worker's involvement with Data, People and Things, and the final three digits merely differentiated one occupation from another by providing a unique nine-digit code for each definition. In addition, worker traits and related counseling-oriented information previously contained in Volume II of the Third Edition was not included in the Fourth Edition. This information was released in two Department of Labor publications, the *Guide for Occupational Exploration (GOE)* published in 1979 and the *Selected Characteristics of Occupations Defined in the DOT* published in 1981.

Basically, the changes in the Fourth Edition were designed to establish a broader occupational base for such purposes as classifying job applications and job orders, making referrals, assessing worker transferability into related jobs, or relocating workers displaced by technological change.

Up until the issuance of the Third Edition, occupational research was focused on expanding the data base by filling gaps in occupational and industrial coverage. In preparing the Fourth Edition, attention was also focused on eliminating overlapping and duplication and verifying and updating existing definitions. As a result, there were actually fewer occupational definitions in the Fourth Edition than in the Third. While some 2,100 new definitions were added, over 3,500 were deleted.

Supplements to the Fourth Edition were published in 1982 and 1986. In the 1986 Supplement, selected data elements were appended to each occupational definition. These

elements were an estimate of math and language development, the amount of standard vocational preparation required, physical demands, environmental conditions, and reference codes to assist users in locating additional information for that particular occupation in the *GOE* and the Department of Commerce's *Standard Occupational Classification Manual*.

In addition, rating structures for Physical Demands and Environmental Conditions were revised after release of the 1982 Supplement and these changes were described in the 1986 Supplement. These changes were made to allow for greater discrimination in rating job situations for physical demands and environmental conditions factors and to increase the reliability of these ratings.

A Revised Fourth Edition is currently being published for release in mid-1991. This Revised Edition will be basically the same format as the 1986 Supplement.

Although the organizational structure of all these editions differed to varying degrees, the basic intent remained the same -- to identify jobs present in the economy and to provide a tool for the employment service to match workers with jobs.

Today's users and uses extend far beyond that basic intent. The *DOT* is widely used by educational institutions, government agencies, private for-profit companies, and non-profit agencies for a variety of purposes, such as career and vocational counseling, library reference, rehabilitation counseling, personnel management, employment placement, and a wide range of research activities.

Changes in the structure, uses, and users of the *DOT* were not the only changes taking place over this period. Due to a series of severe cutbacks in staff and resources at the national level, the organizational structure of the program evolved from a Federal research program to the present Federal-State cooperative occupational analysis effort. Staff of Employment Security agencies, through a network of formally established Occupational Analysis Field Centers, conduct data collection activities to maintain the *DOT* under the general direction of the U. S. Employment Service's Division of Planning and Operations.

Industry Approach to Data Collection. Because occupational content and job characteristics are continually changing, research efforts are focused on the study of selected industries to document the jobs that have undergone the most significant changes. Industries are selected and prioritized for study based on analysis of a considerable number of factors, including:

- Current and projected industry employment statistics;
- Number of occupations identified as existing in an industry;
- Perceived adequacy/currency of existing *DOT* industry coverage;
- Productivity measures for the industry;
- Relative significance of a particular industry to the overall economy;
- Impact of new technologies; and
- Number and type of job orders, applications, and related placement information obtained from local Employment Service offices.

Consideration is also given to the coding structure of industries in the *Standard Industrial Classification Manual (SIC)*, published by the Office of Management and Budget, to identify appropriate combinations of industry segments for inclusion in an industry study. The industry breakdown for *DOT* research purposes groups occupations with similar activities; the *SIC* groups establishments with similar primary end products or services. Subsequently, *DOT* industries have a relationship to jobs that is similar to the relationship the *SIC* has to establishments.

When an industry is assigned to a Field Center for study, analysts conduct considerable research to familiarize themselves with the methods, processes, techniques, procedures, technologies, materials, and key occupations involved in the assigned industry. Typical research may consist of reviewing books, periodicals, and technical literature on industrial or other processes, contacting trade and professional societies and associations, and analyzing company job descriptions, organization charts, and flow charts. This research provides a foundation for determining the scope and focus of the overall industry study as well as a universe of potential establishments to be contacted. Establishments are selected for study based on criteria that provides for broad demographic and geographic representation of firms within the industry. The Occupational Analysis Program relies on the voluntary participation of private and public employers in job analysis studies to gather source data for occupations defined in the *DOT*.

Ideally, all jobs in an establishment should be studied. There are instances, however, when analysts will limit a study to selected departments, sections, or jobs. Priority for study is given to jobs that are considered "unique" to the assigned industry or "critical" to the overall objective of the particular establishment.

Job Analysis Methodology. In modern usage, the word "job" has different meanings depending on how, when, or by whom it is used. "Job" is often used interchangeably with the words "occupation", "position", and "task". To eliminate this confusion and to clarify terms, the USES developed definitions for the following terms for use in job analysis:

- An Element is the smallest step into which it is practical to subdivide any work activity without analyzing separate motions, movements, and mental processes involved.
- A Task is one or more elements and is one of the distinct activities that constitute logical and necessary steps in the performance of work by the worker. A task is created whenever human effort, physical or mental, is exerted to accomplish a specific purpose.
- A Position is a collection of tasks constituting the total work assignment of a single worker. There are as many positions as there are workers in the country.
- A Job is a group of positions within an establishment which are identical with respect to their major or significant tasks and sufficiently alike to justify

their being covered by a single analysis. There may be one or many persons employed in the same job.

- An Occupation is a group of jobs, found at more than one establishment, in which a common set of tasks are performed or are related in terms of similar objectives, methodologies, materials, products, worker actions, and/or worker characteristics.

Element, task, and job are relative concepts; an activity that is an element in one job could be a task in another job, and could be a job in and of itself for a third worker. It is critical in the analysis of jobs to determine where a job begins and where it ends. The analyst must be able to analyze a group of positions, determine the number of jobs existing among the positions, and then determine the exact nature of these jobs. Jobs must be analyzed as they exist; therefore, each completed Job Analysis Report (the basic tool used to structure the job analysis and record data) must reflect the job as it exists at the time of the analysis, not as it should exist, not as it has existed in the past, and not as it exists in similar establishments. Basically, every job analysis should represent a description of one job -- no more, no less.

All job analysis methods require that certain categories of information about jobs be collected, analyzed, and recorded in a systematic way. The method approved by the Employment Service for use by the OA Program recognizes two major dimensions of job information -- Work Performed and Worker Characteristics.

The Work Performed components relate to specific work activities of a job and include:

- Worker Functions. The Worker Functions ratings depict a broad action which summarizes what the worker does in relation to Data, People, and Things and indicates the relative significance of the worker's relationship to these three components. Assignment of the most characteristic Worker Functions provides a basis for structuring the analysis of the job, i.e., is the job machine-related or non-machine related, data-oriented, or people-oriented, or a combination of these factors. Selection of the appropriate Worker Functions requires the analyst to differentiate the incidental from the essential work activities to accurately characterize the job being studied. The numerical ratings for Worker Functions are represented as the middle three digits of the unique nine-digit code assigned to each occupational definition in the DOT.
- Work Fields. Work Fields represent categories of technologies that describe how work gets done and what gets done as a result of the work activities of a job -- the purpose of the job. The concept of Work Fields involves consideration not only of the overall objective or purpose of a job, but also how the objective is attained; that is, the means by which the objective of the job is met. There are ninety-six Work Fields identified for use by the USES

for classification of all jobs in the economy in terms of what gets done on the job, e.g., Abrading, Data Processing, Engineering, and Material Moving.

- The MPSMS (Materials, Products, Subject Matter, and Service) component identifies the materials processed, final products, subject matter being dealt with or applied, and services rendered. The determination and assignment of an appropriate MPSMS code and title is essential to place the job in the appropriate occupational group in the *DOT* and to understand the basic knowledge required of the worker. The MPSMS component contains forty-eight groups subdivided into three-hundred-thirty-six categories, some tangible and some intangible. Categories of tangibles cover materials and products, such as Grains and Alcoholic Beverages; categories of intangibles involve specialized knowledge or services, such as Dramatics and Air Transportation, and cannot be expressed by listing a material or product.
- Machines, Tools, Equipment, and Work Aids (MTEWA) is the component that describes the devices used by the worker to carry out the specific activities of the job.

Sentence Analysis is the technique used by the analyst to determine, in all job-worker situations, the appropriate components of Work Performed. This technique permits even the most complex job-worker situation to be stated in a simple, brief, declarative sentence. This technique uses the answers to three basic questions about the work setting to build a sentence consisting of three standard parts and which describes Work Performed. The three basic questions are:

- 1) What does the worker do? *(Worker Functions)*
- 2) What gets done? or,
What is the purpose of the worker's action? *(Work Fields)*
- 3) What is the final result? *(MPSMS)*

The Worker Characteristics dimension encompasses those job analysis components that reflect the worker attributes that contribute to successful job performance. These components are:

- General Educational Development (GED). This is education of a general nature (non-occupationally specific) that contributes to the reasoning development and the acquisition of mathematical and language skills required of a worker to achieve average satisfactory performance on the job. Ordinarily, such education is obtained in elementary school, high school, or college; however, it may be obtained from experience and self-study. GED is estimated on the basis of discrete scales for Reasoning, Mathematical, and Language development.

- Specific Vocational Preparation (SVP). This component is an estimate of the amount of lapsed time required of a typical worker to learn the techniques, acquire the information, and develop the facility needed for average performance in a specific job-worker situation. This training may be acquired in school, at work, in the military, or other institutional or vocational environment. Specific vocational training includes: vocational education, apprenticeship training, inplant training, on-the-job training, and essential experience in other jobs. The scale for determining SVP is a continuum consisting of nine levels or ranges. Analysts select a range or level that is based on an evaluation of the employer's requirements and on a comparison with other jobs or occupations of similar complexity. By selecting a level of SVP, analysts determine that the typical SVP for that occupation is somewhere within that range and not at any specific point on the range.
- Aptitudes. There are eleven Aptitudes used by USES for job analysis that are indicative of the specific capacities or abilities which an individual must have in order to learn to perform a given work activity. Every aptitude factor is considered independently in the rating process for each job. The analyst estimates the level of each aptitude required of the worker for average, satisfactory performance, based on careful evaluation of the work activities of the job and the specific worker abilities that can be identified in terms of the aptitudes.
- Temperaments. The temperament ratings describe the nature of the job in terms of the adjustments that the worker must make to the work and the work setting, such as working in isolation, working under stress, attaining precise tolerances, and making decisions and judgments. Temperaments are included as a component of job analysis because different job situations call for different personality traits on the part of the worker. Experience in placing individuals in jobs indicates that the degree to which the worker can adapt to work situations is often a determining factor for success. A person's dissatisfaction or failure to perform adequately can sometimes be attributed to an inability to adapt to a work situation rather than an inability to learn and carry out job duties.
- Physical Demands. This component describes the physical activities which a job requires in terms of twenty factors. Ratings are reflective only of the physical demands of the job, not the physical capacity of the worker, and are evaluated based on frequency and force or physical effort exerted.
- Environmental Conditions. The fourteen Environmental Conditions ratings describe the surroundings in which a job is performed. The worker's proximity to moving or mechanical equipment, the noise level, temperature, and atmospheric conditions present are some of the factors considered. For purposes of job analysis, to be considered present an Environmental Condition must be specific and related to the job.

Each job analyzed is also assigned a code indicating a perceived liking or preference of the worker for a specific type of activity that corresponds directly to codes in the *GOE*. This code links that particular job to occupations defined in the *DOT*. The *GOE* provides users with information about the interests, aptitudes, adaptabilities, and other requisites of occupational groups. It is designed for use in self-assessment and counselor-assisted settings to help people see themselves realistically in regard to their ability to meet job requirements.

A combination of observation and interview is the traditional method of data collection accepted by the USES for use by the Occupational Analysis Program. This method may focus either on observation or interview, depending on the particular job-worker situation. Analysts observe workers performing their jobs at the actual work site and interview workers, supervisors, and other establishment officials to gather pertinent information. Questionnaires, inventories, and other approaches are also utilized to obtain supplemental information. This job analysis methodology, although labor and cost intensive, has proven to be the most effective and systematic means of collecting data at the level of detail currently required. Over forty-five "work performed" and "worker characteristics" variables are analyzed, rated, and recorded on the Job Analysis Report for each job studied.

Definition Writing Methodology. Individual job analysis reports are evaluated and grouped, based on analysis of tasks performed, for use in formulating and writing occupational definitions. While there are parallels between preparation of the Job Analysis Report and the *DOT* definition, they are two discrete processes. The analyst defines jobs from several similar positions, while the definition writer defines occupations from several similar jobs. The basic distinction which needs to be drawn is between a job (significantly similar set of work tasks observable in one or more establishments) and an occupation (a summation or composite of information about closely related jobs).

The definition writer has certain latitude beyond that of the job analyst in order to develop workable occupational classifications. The primary basis for combining source data for an occupational definition rests on the common overall objective of the job, Worker Functions, Work Fields, and similarity of tasks. Occupational definitions are the result of comprehensive studies of how similar jobs are performed in establishments across the nation and are composites of data collected from diverse sources. The term "occupation," as used in the *DOT*, refers to this collective description of a number of individual jobs performed, with minor variations, in many establishments. *DOT* definitions are intended to reflect typical occupations and are not meant to coincide in every respect with the content of jobs as performed in particular establishment or localities.

The *Dictionary of Occupational Titles* is unique -- no other publication attempts to describe all jobs in the economy as comprehensively. Whether or not the Occupational Analysis Program should continue in its mission of identifying and defining all jobs in the economy at the current level of detail is currently being reviewed, as are the procedures by which data are collected. In the interim, the methodologies and procedures outlined will continue to provide the basis for job analysis and occupational definition writing.